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By

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Overreaction of country ETFs to US market returns: Intraday vs. daily horizons and the role of synchronized trading

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Abstract

In this paper we study the intraday price formation process of country Exchange Traded Funds (ETFs). We identify specific parts of the US trading day during which Net Asset Values (NAVs), currency rates, premiums and discounts, and the S&P 500 index have special effects on ETF prices, and characterize a special intraday and overnight updating structure between these variables and country ETF prices. Our findings suggest a structural difference between synchronized and non-synchronized trading hours. While during synchronized trading hours ETF prices are mostly driven by their NAV returns, during non-synchronized trading hours the S&P 500 index has a dominant effect. This effect also exceeds the one that the S&P 500 index has on the underlying foreign indices and suggests an overreaction to US market returns when foreign markets are closed.

JEL Classification: G02; G11; G12; G14; G15; G32
Keywords: ETF; Synchronized trading; Overreaction; Hedging; Structured products; Arbitrage

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1. Introduction

In this paper we study the price formation process of country Exchange Traded Funds (ETFs). These ETFs are traded in the US market and are designed to track a wide variety of foreign country indices. As such, they should be exposed only to their home market-risk and not to US market-risk. However, they could be indirectly exposed to US market-risk through two different channels: through the underlying correlation between their foreign home market and the US market; and through potential behavioral biases generated by US market participants. In this paper we analyze the effect the US market has on country ETFs and identify specific parts of the US trading day during which country ETFs indeed overreact to the US market.

In order to do so we examine to what extent country ETF returns are driven by changes to their Net Asset Value (NAV), by currency effects, and by the S&P 500 index. In our analysis we distinguish between the intra-day and inter-day processes and examine their inter-dynamics. We identify specific parts of the US trading day during which each variable's effect is most dominant and characterize a special intraday and overnight updating structure between these variables and country ETF prices. We find that the S&P 500 index accounts for the largest part of ETF returns when foreign markets are closed. This result raises the question of whether the dominant effect the US market return has on country ETF returns during non-synchronized trading hours simply expresses the underlying market integration between the US and the foreign country, or whether it expresses a behavioral bias where traders overreact to local US market sentiment. Our findings support the latter interpretation. We show how the effect the US market return has on country ETFs increases during non-synchronized trading hours, and exceeds that of the long run underlying correlation between the two markets.

Our findings have important implications for both academic and market practitioners' purposes. First, on the academic level, our findings suggest a behavioral bias. When foreign markets are closed and no foreign quotes are available to rely on, US investors overly rely on what is happening in the US and ignore the long-run underlying correlation between the markets.

Second, for market practitioners, our findings suggest that the efficiency of ETF products that experience non-overlapping trading hours with their underlying indices, strongly depends on the investment horizon at stake. Such ETFs could be a useful vehicle to gain exposure to or hedge against foreign market risk only in the long run and for a relatively extended investment horizon. However, in short periods at the intraday level, such ETFs might offer very limited exposure to foreign risk and function as a mere "placebo instrument" if added to a portfolio. In other words, instead of gaining exposure to foreign country risk, an investor is in fact loading additional US market-risk into his portfolio.

The remainder of this paper is organized in the following way. In the next section we describe the mechanics of ETFs in general and of country ETFs in particular, explain their arbitrage mechanism, and review the relevant academic literature. In Section 3 we describe the econometric model we use for analyzing ETF returns. In Section 4 we present the data, followed by Section 5 in which we describe our estimation results for the econometric model. In Section 6 we discuss robustness tests and report their results. Finally, conclusions are brought in Section 7.

2. ETFs: Background and literature

An ETF is a security traded in the secondary market that is designed to track a given index. It does so by holding a portfolio of stocks that replicates the underlying index. Each ETF share represents a unit of ownership on the underlying portfolio which determines its NAV. Dealers can create new ETF share-units or redeem existing share-units at their NAV directly with the fund-sponsor. The discipline of the creation and redemption process is a critical mechanism that ensures that ETF prices remain as close as possible to their NAV. Any deviations between NAVs and ETF prices can be immediately exploited for arbitrage profits. Indeed, several studies have shown how ETFs are priced very closely to their NAV

(Ackert and Tian, 2000; Elton et al., 2002; Engel and Sarkar, 2006; Ackert and Tian, 2008).

Country ETFs are a sub-sector of the ETF market and are designed to track stock market indices of foreign countries. A special feature of country ETFs is that ETF shares and their underlying portfolios are traded in two different markets: The ETF is traded in the US while the underlying portfolio is traded in the foreign home-country. Hence, for country ETFs the arbitrage mechanism described above suffers from the fact that the underlying portfolio and the ETF are often traded during different hours. For instance, Asian markets and US markets have no overlapping trading hours; European markets and US markets have only partial overlapping trading hours. In such cases, the arbitrage mechanism described above essentially does not exist. Consequently, ETF prices fluctuate during the US trading day while their NAVs remain stale. Thus, country ETFs naturally trade at a premium or a discount compared to their underlying foreign stale NAVs. Indeed, several studies show that premiums and discounts are far more frequent among country ETFs compared to other ETF sectors, and that their premiums are larger in magnitude and more persistent (Jares and Lavin, 2004; Engle and Sarkar, 2006; Tse and Martinez, 2007; Ackert and Tian, 2008).

A natural question that arises given the above evidence is to what extent country ETF premiums and discounts reflect rational pricing, or, alternatively, non-rational mispricing. When foreign markets are closed, an arbitrage mechanism no longer exists to discipline any non-rational or behavioral influences that country ETF prices may be subject to. For example, in the absence of active foreign NAVs to rely on, investors may be overly influenced by what is happening in the US market and over-rely on US market returns to price country ETFs. Such influences would have been governed by an arbitrage mechanism and eliminated had foreign markets been open during US trading hours. In order to address this question, we focus on country ETF intraday and overnight returns and characterize their structure.

There are a number of papers that study weekly and monthly returns of country ETFs and find that they do not behave differently from their underlying NAVs and indices, and find no evidence for excessive risk exposure to the US market (see for instance, Pennathur et al., 2002; Taylor, 2005; Tse and Martinez, 2007; Delcoure and Zhong, 2007; Phengpis and Swanson, 2009). Other studies have found evidence for correlation between daily returns of country ETFs and the US market returns (see for example, Hughen and Mathew, 2009; Zhong and Yang, 2005).

However, in all of the above literature, the chosen investment horizon and data frequency may not be suitable for detecting the exact updating mechanism that ETF prices experience, especially when considering the dynamics between intraday and interday price processes. Daily and weekly data on ETF returns may represent time intervals too large to measure significant price formation processes that take place only at the intraday level. For example, any ETF pricing updates that take place at the US market-open in response to prior changes to NAV prices that took place earlier in the day in the foreign home-country remain undetected when using daily returns. Similarly, daily returns are a result of a combination of multiple factors that affected ETF prices non-simultaneously throughout the US trading day: NAV prices could have an effect on the market-open; the S&P 500 index may have an effect throughout the entire trading day; and lagged effects can take place at different parts of the trading day. Moreover, as mentioned above, European markets have partial overlapping trading hours with US markets, and it is most likely that their price formation process experiences different patterns during synchronized and non-synchronized trading hours. In this paper we address this gap in the literature and focus on high-frequency intraday returns to enable a more refined analysis that captures both the intraday and interday processes that affect country ETF prices, as well as the dynamics between the two return horizons. It is these time intervals that also allow for examining potential intraday overreactions and mispricing in country ETF.

In order to carry out our analysis, we use an Error Correction Model (ECM) framework to identify the contribution that each of the following variables has on country ETFs at the intraday level: NAV returns, S&P 500 index returns, currency effects and lagged premiums or discounts between ETFs and their underlying NAV. We also control for different parts of the trading day, such as synchronized and non-synchronized trading hours and market-open vs. regular trading hours.

To preview our results, we find that almost all of the price adjustments to foreign NAVs and lagged premiums or discounts take place at the US market-open. During the rest of the US trading day, when foreign markets are closed, ETF prices mostly follow the S&P 500 index. Interestingly, in countries that have partial overlapping trading hours (i.e., European countries) we find a regime shift between synchronized and non-synchronized trading hours, where the effect the S&P 500 index has on ETF prices increases dramatically after the foreign market closes. Additionally, in all countries during non-synchronized trading hours, the effect the S&P 500 index has on country ETF returns significantly exceeds that which it has on the underlying indices. These results support the hypothesis that ETF prices overreact to US market returns during non-synchronized trading hours.

3. The model

In this section we introduce the econometric model we use to investigate the price formation process of country ETFs. Let $P_{i,t}$ denote the ETF price for country i at time t in the US. Similarly, let $NAV_{i,t}$ denote the NAV value for country i traded in its home market at time t. All prices were transformed by natural logarithms. Let $\Delta P_{i,t}$ and $\Delta NAV_{i,t}$ denote the ETF and the underlying NAV price-differences between time $t-1$ and time t, respectively. Similarly, ΔSP_t denotes the S&P 500 index return between time $t-1$ and time t. All times are local US times measured in 15-minute intervals; all prices and returns are in US dollars. Let $Prem_{i,t}$ denote the premium or discount of ETF i compared to its NAV, i.e., $P_{i,t} - NAV_{i,t}$. This variable is the error correction term in the model, and we expect future ETF prices to adjust accordingly so that any past premiums or discounts are eliminated. Finally, we use two dummy variables to isolate two parts of the trading day that are of special interest. Let D_t be a dummy variable that assigns the value 1 if time t is the US market-open time, and the value 0 otherwise. Let $S_{i,t}$ be a dummy variable that gets the value 1 if time t is a synchronized trading time between country i and US markets, and 0 otherwise. We model the price formation process of the ETF using the following equation:

$$\begin{aligned} \Delta P_{i,t} \;=\;& \alpha_i + \Delta NAV_{i,t}\left(\beta_i^{NAV} + \delta_i^{NAV} S_{i,t} + \gamma_i^{NAV} D_t\right) \\ &+ \Delta SP_t\left(\beta_i^{SP} + \delta_i^{SP} S_{i,t} + \gamma_i^{SP} D_t\right) \\ &+ Prem_{i,t-1}\left(\beta_i^{Prem} + \delta_i^{Prem} S_{i,t} + \gamma_i^{Prem} D_t\right) + \varepsilon_{i,t} \end{aligned} \tag{1}$$

with $i = (1, ..., n)$ and $t = (1, ..., T)$.[1] On the left-hand side is the price return of ETF i at time t in the US. On the right-hand side are three explanatory variables. The first variable is the NAV return at time t. This variable has three coefficients: β_i^{NAV} for all trading hours, additional coefficient δ_i^{NAV} for synchronized trading hours, and additional coefficient γ_i^{NAV} for the US market-open time, respectively. NAV returns express price adjustments and currency adjustments during foreign market regular trading hours, and only currency adjustments when foreign markets are closed. The second variable is the S&P 500 index return at time t. Again, we have three coefficients for this variable for three different parts of the trading day. The third variable is the lagged premium or discount, and again we measure its effect during the same three parts of the trading day.

We split the effect of each variable into three different parts of the US trading day because of the schedule of trading hours between the US and foreign countries. When US markets open, trade has already taken place in Europe and Asia and NAV prices have changed since their last closing prices. This new information may be reflected at the US market-open, and its effect is captured by the coefficient γ_i^{NAV}. Similarly, ETF prices may

[1] We used several different models with richer specifications compared to the one specified in equation (1). However, the qualitative results remained unaltered. We used various GARCH specifications, with and without integration (i.e., an IGARCH model) and with and without ARMA components. Additionally, we estimated a model with and without lagged variables. Finally, we used different time intervals of 1-minute data and 15-minute data. All of our results remain robust to the above changes indicating the stability of our estimates. Thus, for the coherence of the discussion we report results only for the above specification in equation (1). The results for all other specifications can be found in an extended version of this paper at the corresponding author's website: http://ie.technion.ac.il/Home/Users/levy.html .

be updated at the US market-open to eliminate any premiums or discounts from the last trading session that have not been translated into NAV prices on the consecutive trading day in the foreign country. This effect is captured by the coefficients γ_i^{Prem}. Similarly, all variables may have a different effect on ETF prices during synchronized trading hours, when an arbitrage mechanism exists between US markets and foreign markets, and during non-synchronized trading hours, when an arbitrage mechanism does not exist. More specifically, ETF prices can be governed by their corresponding NAV prices when home markets are active. On the other hand, the S&P 500 index returns may have a stronger effect when foreign markets are closed. These effects are captured by the coefficients for synchronized trading hours, δ_i^{NAV}, δ_i^{SP} and δ_i^{Prem}.

4. Data

In order to estimate the above equation we use intraday 15-minute market data downloaded from TradeStation intraday historical data service. We focus our analysis on country ETFs issued by *iShares*, which is the world's largest ETF issuer and market leader owned by BlackRock. Out of approximately 30 different available country ETFs we chose 9 Asian countries and 11 European countries with enough historical data and trading activity to carry out our tests. We downloaded nearly 11 years of data from January 2000 – December 2010 for three different time series: ETFs, NAVs and the S&P 500 index. For ETF prices we used real market quotes. For NAV quotes we used the indicative NAV (INAV), which is an estimate for the NAV published by the exchange every 15 seconds and is based on prices of the underlying securities on an intraday basis. When foreign markets are closed and real NAV prices are stale, INAV quotes reflect only currency adjustments to the last closing prices of the underlying securities. Thus, the data also allow for measuring specific currency effects on ETF prices. Finally, for the S&P 500 index we used quotes for SPY, which is SPDR's ETF that tracks the S&P 500 index. Summary statistics are provided in Table 1.

5. Estimation and results

We carry out our tests in the following order. We start with countries that have no synchronized trading hours with US markets, i.e., Asia and Australia. Then, we address countries that have partial overlapping trading hours with US markets, i.e., European countries.

5.1. Case I: Non-synchronized trading (Asia & Australia)

We start with the case of Asia and Australia. Since there are no synchronized trading hours for this case, the dummy variable $S_{i,t}$ is always zero and can be left out of our model. Table 2 reports regression results for this case.

First, the estimates for the constant term α_i are not significantly different from zero for all countries, which indicates no arbitrage opportunities.

Second, two variables have a special effect at the US market-open: INAV and the lagged premium. The estimates for the effect of INAV at the US market-open ($\beta_i^{NAV} + \gamma_i^{NAV}$) range from 84% to 67% for all countries, and the average effect is 77%. Similarly, the effect that lagged premiums have at the US market-open ($\beta_i^{Prem} + \gamma_i^{Prem}$) is negative and ranges from -42% to -76%, with an average of -58%. All estimates are significant at 1% confidence level. The interpretation of these results is that a significant portion of the price formation of country ETFs takes place at the US market-open, where ETF prices adjust to the new NAVs that were revealed in the foreign markets. Additionally, any premiums or discounts that existed at the last trading session of the previous trading day are eliminated by a price reversal in the opposite direction of the premium or discount.

Third, the effect of INAV during the US trading day (β_i^{NAV}) is very small, often statistically insignificant, with an average effect of 20%. The only two exceptions are Australia and Japan, with effects of 76% and 50%, respectively. In an efficient market, ETF prices are expected to fully adjust to the dollar value of their underlying foreign NAVs. Therefore, our results mean that for most countries ETF prices underreact to currency effects during the US trading day.[2] Similarly, ETF prices do not adjust to any premiums or discounts that open between ETF prices and their NAVs during the US trading session: All estimates for the lagged premium coefficient (β_i^{Prem}) are very close to zero but significant.

Last, the S&P 500 index has a very strong effect, in fact almost an exclusive effect, during the US trading day. After the opening session, the effect of the S&P 500 index on country ETF prices ranges from 74% to 130%, with an average effect of 89%. All estimates are significant at the 1% significance level. The additional effect the S&P 500 index has at the US market-open (γ_i^{SP}) varies from country to country, with positive, negative and zero effects. However, for all countries this additional effect is of much smaller magnitude compared to the S&P 500 effect during the US trading day. Finally, all $\overline{R}^2$ values range from 75% to 88% indicating strong explanatory power for our estimates.

In order to determine whether these effects indicate mispricing and reflect an overreaction to the US market, we compare these effects and the effects the S&P 500 index has on the underlying indices. Tables 4 and 5 report the effect the S&P 500 index has on the underlying indices of the Asian ETFs, when regressing next day returns of the underlying indices on daily S&P 500 returns. As can be seen in Table 4, in most countries, this effect is below 50%, with only Australia experiencing a relatively high effect of nearly 79%. On average this effect is 49%. It is less than half compared to an average of 89% for the intraday effect the S&P 500 has on the corresponding ETFs, as reported in Table 2.

We also examine to what extent the 15-minute time interval we chose accounts for the differences in correlations. Hence, we compare the above effects the S&P 500 index has on the

[2] It can be argued that changes in the exchange rate could influence ETF prices through two separate channels. One direct channel is the currency adjustments of the underlying foreign NAV, as we describe above. Another channel could be a potential influence the exchange rate has on the underlying foreign index, which in return determines ETF prices. Such an indirect effect may arise due to a potential correlation between the performance of the country's exchange rate and the performance of its equity markets. We tested for such additional indirect effects and found no evidence for them in almost all countries in our sample. Thus, we focus our attention only on the direct effect as we stated above. Japan and Australia were the only two exceptions where some correlation was found. Interestingly, these are the two countries for which we find stronger ETF adjustments to currency effects, as reported in Table 2. (We thank an anonymous referee for these insightful comments.)

underlying indices (as reported in Tables 4 and 5) and those it has on ETF returns, this time calculated over market-open to market-close time intervals. The latter results are reported in Table 6. As can be seen, the correlations are of the same magnitude as those received for the 15-minute intervals (89% vs. 92% on average, respectively), and thus we conclude that our qualitative results remain unchanged. These findings support the hypothesis that during the US trading day ETF returns overreact to US market returns.

In summary, our results for the case of countries that have no synchronized trading hours with US markets suggest the following pricing pattern. At the US market-open ETF prices adjust to the new NAVs revealed at their foreign home markets and correct for any lagged premiums and discounts. Thereafter, during the US trading day, ETF prices are largely driven by the S&P 500 index with little adjustment to currency effects or any lagged premiums and discounts. The effect the S&P 500 index has on ETF intraday returns exceeds that which it has on the underlying indices, indicating an overreaction to the US market. This overreaction is then corrected for at the opening of the following US trading day.

5.2. Case II: Synchronized & non-synchronized trading (Europe)

In the second case we examine country ETFs that have partial overlapping trading hours with their underlying foreign home markets, i.e., European countries. Markets in Europe are open during the first part of the US trading day (typically until 11:30 AM EST) and are closed thereafter. Hence, these ETFs experience synchronized and non-synchronized trading hours. Our estimation results for this case are presented in Table 3.

First, just like the previous case for Asia, the estimates for the constant term α_i are not significantly different from zero for all countries, which indicates no arbitrage opportunities.

Second, unlike the case for Asia, INAV has a strong effect on ETF returns. Moreover, INAV has a stronger effect during synchronized trading hours compared to non-synchronized trading hours. During synchronized trading hours, the total effect ($\beta_i^{NAV} + \delta_i^{NAV}$) ranges from 87% to 76% for all countries, with an average of 82%. During non-synchronized trading hours, the INAV effect (β_i^{NAV}) decreases to an average of 65%, and ranges from 80% to 42%. As explained above, during non-synchronized trading hours INAV changes express only currency effects. Our results thus mean that European ETFs underreact to currency effects and do not reflect a full adjustment to the dollar value of the underlying foreign NAV. However, currency effects are higher compared to the ones observed in the Asian case. Finally, in the European case there are no special INAV effects at the US market-open; the average marginal effect (γ_i^{NAV}) is approximately 6% and often not significantly different from zero.

Third, lagged premiums and discounts, as in the Asian case, have a strong negative effect at the US market-open ($\beta_i^{Prem} + \delta_i^{Prem} + \gamma_i^{Prem}$) and range from -90% to -60%, with an average effect of -80%. Conversely, during the US trading day, for both synchronized or non-synchronized trading hours, lagged premiums have a very marginal effect with an average of 2% to 12%, respectively.

Last, the S&P 500 index effects during synchronized and non-synchronized trading hours are of different magnitude. During synchronized trading hours, the S&P 500 effect ($\beta_i^{SP} + \delta_i^{SP}$) ranges from 10% to 39% with an average effect of 20%. On the other hand, during non-synchronized trading hours, its effect (β_i^{SP}) increases dramatically, ranging from 65% to 103%, with an average effect of 81%. At the US market-open, the S&P 500 index does not seem to have an additional significant effect.

This regime shift in the effect the S&P 500 index has on European ETF returns between synchronized and non-synchronized trading hours supports the hypothesis that ETF returns overreact to US market returns when foreign markets are closed. As long as European markets are open, the S&P 500 index has a significantly reduced effect and the dominant price driver is the foreign NAV. However, once foreign markets close, the effect of the S&P 500 index more than triples, on average.[3]

[3] We carried out robustness tests to ensure that this result is not driven by a generic asset correlations pattern during morning trading hours in the US, a pattern that is unrelated to any synchronized or

This phenomenon is further emphasized when we compare the effect the S&P 500 index has on European ETFs and the one it has on their underlying indices. Table 4 reports these effects when regressing next day returns of the underlying indices on daily S&P 500 returns. In most European countries, this effect is below 50%, with Austria experiencing the highest effect of nearly 51%. On average this effect is 38%. It is less than half when compared to the effect the S&P 500 has on the corresponding intraday ETF returns during non-synchronized trading hours (81% on average, as reported in Table 3). The effect the S&P 500 has during synchronized trading hours is much closer to the effect it has on the underlying indices.

To further support the last result, just like in the Asian case, we additionally examined to what extent the 15-minute time interval we chose accounts for the differences in correlations. Hence, we compare the above effects the S&P 500 index has on the underlying indices (as reported in Tables 4 and 5) and those it has on ETF returns, this time calculated over the entire non-synchronized part of the US trading day. The latter results are reported in Table 6. As can be seen, the correlations are of the same magnitude as those received for the 15-minute intervals (81% vs. 91% on average, respectively), and thus we conclude that our qualitative results remain unchanged. These last two results fortify our conclusion from the regime shift reported above and further support the hypothesis that during the US trading day ETF returns overreact to US market returns.

In summary, our results for the case of country ETFs that experience both synchronized and non-synchronized trading hours with US markets show a great difference in their pricing pattern between the two parts of the US trading day. The roles of NAV and the S&P 500

non-synchronized trading environments. We reran equation (1) for Asian ETFs, this time testing for a structural break in the effect that S&P 500 index returns have on Asian ETF returns before and after 11:30 AM EST, even though there is no shift from synchronized to non-synchronized trading for Asian countries. In this way we created a control group of Asian ETFs that have no synchronized trading hours with US markets, yet allow us to explore whether the effect of the S&P 500 index experiences a structural break corresponding to the one found in European ETFs. Our results showed that the structural break is not repeated in the Asian case. Thus, we conclude that it is not caused by a generic asset correlation during the first part of the US trading day, but rather by the discontinuation of the arbitrage mechanism when European markets close. The results for these regressions can be found in an extended version of this paper at the corresponding author's website: http://ie.technion.ac.il/Home/Users/levy.html .

index in determining the price of the ETF switch during synchronized and non-synchronized trading hours. During synchronized trading hours, when an arbitrage mechanism exists between ETFs and their NAVs, ETF prices are mostly driven by NAV values. When this arbitrage mechanism becomes unavailable during non-synchronized trading hours, INAV prices, which simply reflect currency adjustments, become less dominant, whereas the effect of the S&P 500 index becomes much more dominant. Moreover, this increased effect during non-synchronized trading hours exceeds the one the S&P 500 index has on the underlying indices. Both these results indicate an overreaction to the US market when foreign markets are closed. Additionally, the updating mechanism of ETF prices for any premiums and discounts at the beginning of the US trading day is very dominant, similar to the case of Asian countries. Finally, $\overline{R}^2$ values range from 70% to 92% indicating strong explanatory power for the model.

6. Robustness tests

In this section we test for the stability of our results over time. We run our regression as specified in equation (1) for four different years separately, from 2007 to 2010. We focus our attention on the effect of two variables: S&P 500 index returns and lagged ETF premiums, for each year. Our results for the Asian case are reported in Table 7 and those for the European case in Table 8.

In both cases our qualitative results do not change over the course of the four years. First, the total effect of the S&P 500 index and of lagged premiums are quite stable over the years, though they experience some changes from one year to another. This is expected given the financial crisis that took place during 2008–2009. However, the qualitative results are left intact. In Asia, the S&P 500 index in all countries has a significant and strong effect that ranges from 82% in 2010 to 110% in 2007, on average. Similarly, lagged premiums have very little effect in all years during the US trading day, but at the US market-open they have a strong negative effect of around -50% in all years. The same holds for Europe: During synchronized trading hours the effect of the S&P 500 is relatively small (zero in 2008 and 20% in 2010, on average), whereas during non-synchronized trading hours its effect increases dramatically (55% in 2008 and 93% in 2010, on average). Similarly the pattern for the lagged premium is maintained over the course of all four years: Throughout the day the effects of lagged premiums are close to zero, whereas at the US market-open they have a strong effect (60%–70% on average).

7. Summary

The purpose of this paper was to study the efficiency of country ETFs as tracking instruments that are designed to follow foreign indices. We focused our attention on their potential overreactions to US market-risk, and distinguished between the daily and the intraday investment horizon. In our analysis we identified dominant factors affecting country ETF returns during different parts of the US trading day and their inter-dynamics with daily returns. Our findings suggest the following price formation structure.

First, a major price adjustment takes place at the US market-open. At the beginning of the US trading day, ETF prices adjust to their realized foreign NAV returns and correct for any lagged premiums or discounts remaining from the previous trading day.

Second, during the US trading day we find a robust difference between synchronized and non-synchronized trading hours. As long as foreign markets are open and NAVs are actively traded, foreign home markets govern the returns of country ETFs in the US. On the other hand, when foreign markets are closed, we find that the S&P 500 index accounts for the largest part of country ETF returns.

Finally, the increased effect we find for S&P 500 returns on ETF returns during non-synchronized trading hours indicates an overreaction to the US market and is supported by two results. One result is that in countries that have partial synchronized trading hours with the US market (i.e., Europe) we find a regime shift in the effect the S&P 500 index has on country ETFs. During synchronized trading hours, when an arbitrage mechanism exists between ETFs and their NAVs, ETF prices are mostly driven by NAV values. When this arbitrage mechanism becomes unavailable during non-synchronized trading hours, INAV prices become less dominant, whereas the effect of the S&P 500 index becomes much more dominant. The increased effect during the non-synchronized part of the US trading day then matches the effect the S&P 500 index has on country ETFs with no overlapping trading hours (i.e., Asia). The other result is that in all countries the effect the S&P 500 index has on ETF intraday returns exceeds the one it has on the underlying indices. Both these findings support the hypothesis that country ETFs overreact to the US market when foreign markets are closed.

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References

Ackert, L.F., Tian, Y.S., 2000. Arbitrage and valuation in the market for Standard and Poor's depositary receipts. Financial Management, 71–88.

Ackert, L.F., Tian, Y.S., 2008. Arbitrage, liquidity, and the valuation of exchange-traded funds. Financial Markets, Institutions, and Instruments 17, 331–362.

Delcoure, N., Zhong, M., 2007. On the premiums of iShares. Journal of Empirical Finance 14, 168–195.

Elton, E.J., Gruber, M.J., Comer, G., Li, K., 2002. Spiders: Where are the bugs? Journal of Derivatives, 27–45.

Engle, R., Sarkar, D., 2006. Premiums-discounts and exchange traded funds. Journal of Derivatives 13, 27–45.

Hughen, J.C., Mathew, P.G., 2009. The efficiency of international information flow: Evidence from the ETF and CEF prices. International Review of Financial Analysis 18, 40–49.

Jares, T.E., Lavin, A.M., 2004. Japan and Hong Kong Exchange Traded Funds (ETFs): Discounts, returns, and trading strategies. Journal of Financial Services Research 25, 57–69.

Pennathur, A.K., Delcoure, N., Anderson, D., 2002. The performance and diversification of iShares and closed-end country funds. Journal of Financial Research 25, 541–557.

Phengpis, C., Swanson, P.E., 2009. iShares and the US market risk exposure. Journal of Business Finance & Accounting 36, 972–986.

Taylor, A., 2005. Discussion of risk exposures and international diversification: Evidence from iShares. Journal of Business Finance & Accounting 32, 773–776.

Tse, Y., Martinez, V., 2007. Price discovery and informational efficiency of international iShares funds. Global Finance Journal 18, 1–15.

Zhong, M., Yang, H., 2005. Risk exposures and international Diversification: Evidence from iShares. Journal of Business Finance & Accounting 32, 737–771.

Table 1

Summary Statistics

Country	Ticker	Underlying Index	Begin	End	# of Obs.
		Asia:			
Australia	EWA	MSCI Australia	12/14/2000	12/13/2010	476,020
Hong Kong	EWH	MSCI Hong Kong	12/15/2000	12/14/2010	541,739
Japan	EWJ	MSCI Japan	12/15/2000	12/14/2010	786,598
Malaysia	EWM	MSCI Malaysia	12/15/2000	12/14/2010	437,354
Singapore	EWS	MSCI Singapore	12/15/2000	12/14/2010	469,594
Taiwan	EWT	MSCI Taiwan	12/15/2000	12/14/2010	556,240
South Korea	EWY	MSCI South Korea	12/15/2000	12/14/2010	548,825
China	FXI	FTSE/Xinhua China 25 Index	10/08/2004	12/14/2010	521,496
Thailand	THD	MSCI Thailand	03/28/2008	12/14/2010	84,394
		Europe:			
Sweden	EWD	MSCI Sweden	12/15/2000	12/14/2010	198,274
Germany	EWG	MSCI Germany	12/26/2000	12/23/2010	430,940
Switzerland	EWL	MSCI Switzerland	12/15/2000	12/14/2010	171,500
Austria	EWO	MSCI Austria Investable Market	12/19/2000	12/14/2010	192,537
Spain	EWP	MSCI Spain	12/15/2000	12/14/2010	193,610
France	EWQ	MSCI France	12/15/2000	12/14/2010	156,968
United Kingdom	EWU	MSCI United Kingdom	01/03/2000	12/27/2010	352,595
Turkey	TUR	MSCI Turkey	03/28/2008	12/14/2010	95,787

Table 2
Regression Results: 15-Min Data Non-Synchronized Trading
(Asia & Australia)

Country	Const. α_i	ΔINAV[1] β_i^{NAV}	ΔINAV_Open[2] γ_i^{NAV}	ΔS&P β_i^{SP}	ΔS&P_Open γ_i^{SP}	Prem β_i^{Prem}	Prem_Open γ_i^{Prem}	$\bar{R}^2$
Australia	0.000	0.764	0.076	0.806	0.029	-0.010	-0.746	0.882
	0.226	*0.000*	*0.000*	*0.000*	*0.001*	*0.000*	*0.000*	
Hong Kong	0.000	0.093	0.663	0.940	-0.134	-0.007	-0.640	0.794
	0.910	*0.172*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
Japan	0.000	0.498	0.176	0.776	0.105	-0.004	-0.559	0.753
	0.982	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
Malaysia	0.000	0.084	0.742	0.734	-0.184	-0.019	-0.519	0.635
	0.027	*0.001*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
Singapore	0.000	0.275	0.553	0.914	-0.197	-0.015	-0.655	0.807
	0.405	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
Taiwan	0.000	0.063	0.683	0.927	0.100	-0.010	-0.495	0.748
	0.776	*0.001*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
South Korea	0.000	0.016	0.739	0.999	0.058	-0.005	-0.578	0.798
	0.373	*0.040*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
China	0.000	0.035	0.662	1.129	-0.175	-0.005	-0.570	0.870
	0.816	*0.569*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
Thailand	0.000	-0.004	0.822	0.739	-0.018	-0.014	-0.401	0.752
	0.009	*0.936*	*0.000*	*0.000*	*0.586*	*0.000*	*0.000*	
Averages	***0.000***	***0.203***	***0.568***	***0.885***	***-0.046***	***-0.010***	***-0.574***	***0.782***

Notes: This table reports regression results for our model as defined in Equation (1) for Asia & Australia, which experience only non-synchronized trading hours with the US (i.e., $\delta_{i,t} = 0$ for all *t*): $\Delta P_{i,t} = \alpha_i + \Delta INAV_{i,t}(\beta_i^{NAV} + \gamma_i^{NAV} D_t) + \Delta SP_t(\beta_i^{SP} + \gamma_i^{SP} D_t) + \Delta Prem_{i,t-1}(\beta_i^{Prem} + \gamma_i^{Prem} D_t) + \varepsilon_{i,t}$. We regress ETF returns for country i ($\Delta P_{i,t}$) on the following variables: a constant (α_i); INAV returns ($\Delta INAV_{i,t}$) during non-synchronized trading hours (β_i^{NAV}) and their additional effect at the US market-open (γ_i^{NAV}); S&P returns (ΔSP_t) during non-synchronized trading hours (β_i^{SP}) and their additional effect at the US market-open (γ_i^{SP}); and lagged ETF premiums or discounts ($\Delta Prem_{i,t-1}$) during non-synchronized trading hours (β_i^{Prem}) and their additional effects at the US market-open (γ_i^{Prem}). All time intervals are calculated on a 15-minute base. Coefficient estimates are reported in the first row for each country, followed by their P-values in the second row.

[1] INAV changes express only currency adjustments to NAV during non-synchronized trading hours. Thus, the reported estimates meausre only the pure currency effect.

[2] INAV changes at the US market-open express both currency and equilty price adjusments. Thus, the reported estimates measure their total effect.

Table 3
Regression Results: 15-Min Data Synchronized & Non-Synchronized Trading
(Europe)

Country	Const. α_i	ΔINAV[1] β_i^{NAV}	ΔINAV_Synchronized[2] δ_i^{NAV}	ΔINAV_Open[2] γ_i^{NAV}	ΔS&P β_i^{SP}	ΔS&P_Synchronized δ_i^{SP}	ΔS&P_Open γ_i^{SP}	Prem β_i^{Prem}	Prem_Synchronized δ_i^{Prem}	Prem_Open γ_i^{Prem}	$\bar{R}^2$
Sweden	0.00	0.80	-0.04	0.19	0.90	-0.60	-0.16	0.00	-0.06	-0.82	0.90
	0.41	*0.00*	*0.00*	*0.35*	*0.00*	*0.00*	*0.00*	*0.62*	*0.00*	*0.00*	
Germany	0.00	0.76	0.11	0.06	0.69	-0.56	0.00	-0.02	-0.14	-0.73	0.92
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.99*	*0.00*	*0.00*	*0.00*	*0.00*	
Switzerland	0.00	0.70	0.12	0.06	0.65	-0.54	0.04	-0.02	-0.09	-0.70	0.83
	0.52	*0.00*	*0.09*	*0.01*	*0.00*	*0.18*	*0.00*	*0.00*	*0.00*	*0.00*	
Austria	0.00	0.60	0.24	0.00	0.77	-0.63	0.24	-0.02	-0.06	-0.53	0.70
	0.66	*0.00*	*0.94*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	
Spain	0.00	0.78	0.09	0.03	0.81	-0.71	0.10	-0.02	-0.08	-0.80	0.90
	0.10	*0.00*	*0.18*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	
France	0.00	0.43	0.41	0.03	0.82	-0.63	0.07	-0.03	-0.21	-0.65	0.88
	0.07	*0.00*	*0.37*	*0.00*	*0.00*	*0.10*	*0.00*	*0.00*	*0.00*	*0.00*	
United Kingdom	0.00	0.43	0.33	0.05	0.82	-0.59	0.10	-0.02	-0.05	-0.63	0.86
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	
Turkey	0.00	0.74	0.06	0.09	1.03	-0.64	-0.15	-0.03	-0.08	-0.59	0.80
	0.04	*0.00*	*0.03*	*0.38*	*0.00*	*0.02*	*0.00*	*0.00*	*0.00*	*0.00*	
Average	***0.000***	***0.655***	***0.164***	***0.063***	***0.811***	***-0.612***	***0.030***	***-0.019***	***-0.096***	***-0.680***	***0.847***

Notes: This table reports regression results for our model as defined in Equation (1) for European ETFs: $\Delta P_{i,t} = \alpha_i + \Delta INAV_{i,t}(\beta_i^{NAV} + \delta_i^{NAV} S_t + \gamma_i^{NAV} D_t) + \Delta SP_t(\beta_i^{SP} + \delta_i^{SP} S_t + \gamma_i^{SP} D_t) + \Delta Prem_{i,t-1}(\beta_i^{Prem} + \delta_i^{Prem} S_t + \gamma_i^{Prem} D_t) + \varepsilon_{i,t}$. We regress ETF returns for country i ($\Delta P_{i,t}$) on the following variables: a constant (α_i); INAV returns ($\Delta INAV_{i,t}$) during non-synchronized trading hours (β_i^{NAV}), their marginal effect during synchronized trading hours (δ_i^{NAV}), and their marginal effect at the US market-open (γ_i^{NAV}); S&P returns (ΔSP_t) during non-synchronized trading hours (β_i^{SP}), their marginal effect during synchronized trading hours (δ_i^{SP}), and their marginal effect at the US market-open (γ_i^{SP}); and finally lagged ETF premiums or discounts ($\Delta Prem_{i,t-1}$) during non-synchronized trading hours (β_i^{Prem}), their marginal effect during synchronized trading hours (δ_i^{Prem}), and their marginal effect at the US market-open (γ_i^{Prem}). All time intervals are calculated on a 15-minute base. Coefficient estimates are reported in the first row for each country, followed by their P-values in the second row.

[1] INAV changes express only currency adjustments to NAV during non-synchronized trading hours. Thus, the reported estimates meausre only the pure currency effect.

[2] INAV changes at the US market-open and during synchronized trading hours express both currency and equilty price adjusments. Thus, the reported estimates measure their total effect.

Table 4

Daily Correlation between S&P 500 Index and Underlying Indices

Beta Correlations: 2007 - 2010

Asia			
Country	**Const.** *(α)*	**ΔS&P** *(β)*	$\bar{R}^2$
MSCI Australia	0.000	0.785	0.340
	0.557	*0.000*	
MSCI Hong Kong	0.000	0.428	0.163
	0.551	*0.000*	
MSCI Japan	0.000	0.540	0.275
	0.645	*0.000*	
MSCI Malaysia	0.000	0.303	0.162
	0.173	*0.000*	
MSCI Singapore	0.000	0.379	0.124
	0.524	*0.000*	
MSCI Taiwan	0.000	0.447	0.182
	0.000	*0.000*	
MSCI South Korea	0.000	0.597	0.159
	0.434	*0.000*	
MSCI Thailand	0.000	0.320	0.074
	0.000	*0.000*	
FTSE/Xinhua China 25 Index	0.000	0.591	0.151
	0.540	*0.000*	
Averages	***0.000***	***0.488***	***0.181***

Europe			
Country	**Const.** *(α)*	**ΔS&P** *(β)*	$\bar{R}^2$
MSCI Sweden	0.000	0.386	0.068
	0.620	*0.000*	
MSCI Germany	0.000	0.286	0.058
	0.801	*0.000*	
MSCI Switzerland	0.000	0.308	0.110
	0.000	*0.000*	
MSCI Austria Investable Market	0.000	0.505	0.105
	0.597	*0.000*	
MSCI Spain	0.000	0.353	0.070
	0.966	*0.000*	
MSCI France	0.000	0.368	0.089
	0.979	*0.000*	
MSCI United Kingdom	0.000	0.370	0.100
	0.889	*0.000*	
MSCI Turkey	0.000	0.475	0.082
	0.463	*0.000*	
Averages	***0.000***	***0.381***	***0.085***

Notes: This table reports daily *beta* correlations between S&P 500 index returns and the returns of the underlying indices of the different country ETFs. We regress: $\Delta INDEX_{i,t} = \alpha_i + \beta_i \Delta SP_t + \varepsilon_{i,t}$, where $\Delta INDEX_{i,t}$ are daily returns for country *i* underlying index , and ΔSP_t are S&P daily returns. All daily returns are calculated for market-close on day *t* from market-close on day *t-1*. Coefficient estimates are reported in the first row for each country, followed by their P-values in the second row.

Table 5

Correlation between Daily S&P 500 Index and Underlying Indices

Beta Coefficient by Year: 2007-2010

Asia				
Country	**ΔS&P Coefficient**			
	2007	*2008*	*2009*	*2010*
MSCI Australia	0.987	0.844	0.623	0.692
MSCI Hong Kong	0.859	0.376	0.413	0.321
MSCI Japan	0.503	0.580	0.487	0.479
MSCI Malaysia	0.735	0.224	0.278	0.363
MSCI Singapore	0.773	0.327	0.366	0.301
MSCI Taiwan	0.756	0.411	0.365	0.525
MSCI South Korea	0.903	0.551	0.535	0.664
MSCI Thailand	0.489	0.264	0.332	0.344
FTSE/Xinhua China 25 Index	1.120	0.552	0.528	0.486
Averages	***0.738***	***0.459***	***0.436***	***0.464***

Europe				
Country	**ΔS&P Coefficient**			
	2007	*2008*	*2009*	*2010*
MSCI Sweden	0.462	0.490	0.243	0.090
MSCI Germany	0.286	0.354	0.162	0.169
MSCI Switzerland	0.234	0.422	0.131	0.191
MSCI Austria Investable Market	0.492	0.638	0.304	0.266
MSCI Spain	0.252	0.478	0.212	0.098
MSCI France	0.311	0.493	0.167	0.214
MSCI United Kingdom	0.313	0.484	0.202	0.181
MSCI Turkey	0.788	0.576	0.201	0.285
Averages	***0.392***	***0.492***	***0.203***	***0.187***

Notes: This table reports daily *beta* correlations between S&P 500 index returns and the returns of the underlying indices of the different country ETFs. We regress: $\Delta INDEX_{i,t} = \alpha_i + \beta_i \Delta SP_t + \varepsilon_{i,t}$, where $\Delta INDEX_{i,t}$ are daily returns for country *i* underlying index , and ΔSP_t are S&P daily returns. All daily returns are calculated for market-close on day *t* from market-close on day *t-1*. Coefficient estimates are reported in the first row for each country, followed by their P-values in the second row.

Table 6
Correlation between S&P 500 Index and ETFs
Open-to-Close Returns 2007-2010

Asia					Europe			
Country	**Const.** *(α)*	**ΔS&P** *(β)*	$\bar{R}^2$		**Country**	**Const.** *(α)*	**ΔS&P** *(β)*	$\bar{R}^2$
Australia	0.000	1.085	0.847		**Sweden**	0.000	1.025	0.829
	0.269	*0.000*				*0.111*	*0.000*	
Hong Kong	0.000	0.958	0.860		**Germany**	0.000	0.787	0.827
	0.043	*0.000*				*0.000*	*0.000*	
Japan	0.000	0.719	0.819		**Switzerland**	0.000	0.740	0.766
	0.116	*0.000*				*0.121*	*0.000*	
Malaysia	0.000	0.650	0.714		**Austria**	0.000	0.886	0.723
	0.012	*0.000*				*0.057*	*0.000*	
Singapore	0.000	0.874	0.848		**Spain**	0.000	0.899	0.826
	0.258	*0.000*				*0.045*	*0.000*	
Taiwan	0.000	0.894	0.834		**France**	0.000	0.899	0.849
	0.000	*0.000*				*0.029*	*0.000*	
South Korea	0.000	1.040	0.842		**United Kingdom**	0.000	0.871	0.850
	0.111	*0.000*				*0.000*	*0.000*	
Thailand	0.000	0.793	0.621		**Turkey**	0.001	1.234	0.807
	0.079	*0.000*				*0.000*	*0.000*	
China	0.000	1.289	0.829					
	0.078	*0.000*						
Averages	***0.000***	***0.922***	***0.802***		***Averages***	***0.000***	***0.918***	***0.810***

Notes: This table reports open-to-close return correlations for the S&P 500 index and country ETFs. We regress: $\Delta P_{i,t} = \alpha_i + \beta_i \Delta SP_t + \varepsilon_{i,t}$, where $\Delta P_{i,t}$ are open-to-close returns for country *i* ETF, and ΔSP_t are the S&P open-to-close returns. We limit our analysis for non-synchronized trading hours. Thus, for Asian country ETFs these are regular US open-to-close returns; and for European ETFs these are returns from when European markets close (around 11:30 am EST) until US markets close. All coefficient estimates are reported in the first row for each country, followed by their P-values in the second row.

Table 7
Regression Results per Year, 2007-2010
(Asia & Australia)

Country	Variable	2007		2008		2009		2010	
		Coefficient	P-Value	Coefficient	P-Value	Coefficient	P-Value	Coefficient	P-Value
Average all Countries:	***ΔS&P***	***1.099***		***0.913***		***0.845***		***0.820***	
	Prem	***-0.012***		***-0.006***		***-0.012***		***-0.009***	
	Prem_Open	***-0.521***		***-0.493***		***-0.550***		***-0.451***	
Australia	*ΔS&P*	0.747	*0.000*	0.818	*0.000*	0.787	*0.000*	0.939	*0.000*
	Prem	-0.009	*0.002*	-0.010	*0.000*	-0.010	*0.000*	-0.009	*0.000*
	Prem_Open	-0.762	*0.000*	-0.785	*0.000*	-0.688	*0.000*	-0.625	*0.000*
	$\overline{R}^2$	0.868		0.897		0.900		0.934	
Hong Kong	*ΔS&P*	1.252	*0.000*	0.970	*0.000*	0.881	*0.000*	0.818	*0.000*
	Prem	-0.006	*0.007*	-0.005	*0.003*	-0.009	*0.000*	-0.013	*0.000*
	Prem_Open	-0.706	*0.000*	-0.642	*0.000*	-0.540	*0.000*	-0.557	*0.000*
	$\overline{R}^2$	0.826		0.848		0.842		0.808	
Japan	*ΔS&P*	0.694	*0.000*	0.828	*0.000*	0.791	*0.000*	0.755	*0.000*
	Prem	-0.007	*0.000*	-0.001	*0.665*	-0.006	*0.000*	-0.008	*0.000*
	Prem_Open	-0.508	*0.000*	-0.509	*0.000*	-0.498	*0.000*	-0.502	*0.000*
	$\overline{R}^2$	0.705		0.816		0.759		0.729	
Malaysia	*ΔS&P*	1.001	*0.000*	0.764	*0.000*	0.626	*0.000*	0.625	*0.000*
	Prem	-0.020	*0.000*	-0.029	*0.000*	-0.021	*0.000*	-0.014	*0.000*
	Prem_Open	-0.555	*0.000*	-0.437	*0.000*	-0.644	*0.000*	-0.449	*0.000*
	$\overline{R}^2$	0.643		0.629		0.705		0.743	
Singapore	*ΔS&P*	1.177	*0.000*	0.948	*0.000*	0.830	*0.000*	0.760	*0.000*
	Prem	-0.016	*0.000*	-0.014	*0.000*	-0.018	*0.000*	-0.017	*0.000*
	Prem_Open	-0.586	*0.000*	-0.727	*0.000*	-0.651	*0.000*	-0.688	*0.000*
	$\overline{R}^2$	0.769		0.869		0.868		0.868	
Taiwan	*ΔS&P*	1.121	*0.000*	0.970	*0.000*	0.849	*0.000*	0.781	*0.000*
	Prem	-0.009	*0.000*	-0.012	*0.000*	-0.007	*0.000*	-0.001	*0.296*
	Prem_Open	-0.456	*0.000*	-0.620	*0.000*	-0.418	*0.000*	-0.006	*0.665*
	$\overline{R}^2$	0.744		0.815		0.756		0.596	
South Korea	*ΔS&P*	1.231	*0.000*	1.038	*0.000*	0.955	*0.000*	0.917	*0.000*
	Prem	-0.007	*0.000*	-0.010	*0.000*	-0.004	*0.008*	-0.004	*0.032*
	Prem_Open	-0.594	*0.000*	-0.681	*0.000*	-0.568	*0.000*	-0.498	*0.000*
	$\overline{R}^2$	0.790		0.836		0.889		0.854	
China	*ΔS&P*	1.572	*0.000*	1.248	*0.000*	1.086	*0.000*	1.027	*0.000*
	Prem	-0.025	*0.000*	0.000	*0.730*	-0.007	*0.000*	-0.010	*0.000*
	Prem_Open	0.000	*0.013*	0.000	*0.427*	-0.544	*0.000*	-0.538	*0.000*
	$\overline{R}^2$	0.667		0.654		0.885		0.857	
Thailand	*ΔS&P*	NA	*NA*	0.635	*0.000*	0.804	*0.000*	0.760	*0.000*
	Prem	NA	*NA*	0.024	*0.043*	-0.026	*0.020*	-0.004	*0.258*
	Prem_Open	NA	*NA*	-0.032	*0.210*	-0.397	*0.000*	-0.198	*0.000*
	$\overline{R}^2$	NA		0.423		0.746		0.446	

Notes: This table reports regression results for our model as defined in Equation (1) for Asia & Australia, this time for each year separately: 2007-2010. See Table 2 for regression specifications and variable definitions. We report results for the variables of interest: S&P returns (ΔS&P); lagged ETF premiums or discounts (Prem); and additional lagged ETF premiums or discounts at the US market-open (Prem_Open). All time intervals are calculated on a 15-minute base.

Table 8
Regression Results per Year, 2007-2010
(Europe)

Country	Variable	2007 Coefficient	2007 P-Value	2008 Coefficient	2008 P-Value	2009 Coefficient	2009 P-Value	2010 Coefficient	2010 P-Value
Average all Countries:	***ΔS&P***	***0.735***		***0.794***		***0.784***		***0.933***	
	ΔS&P_Synchronized	***-0.607***		***-0.568***		***-0.454***		***-0.728***	
	Prem	***-0.008***		***-0.013***		***-0.028***		***-0.040***	
	Prem_Open	***-0.579***		***-0.547***		***-0.674***		***-0.660***	
Sweden	*ΔS&P*	0.883	*0.000*	0.799	*0.000*	0.864	*0.000*	1.057	*0.000*
	ΔS&P_Synchronized	-0.741	*0.000*	-0.712	*0.000*	-0.256	*0.002*	-0.752	*0.000*
	Prem	-0.004	*0.558*	0.018	*0.024*	-0.023	*0.022*	-0.058	*0.000*
	Prem_Open	-0.798	*0.000*	-0.873	*0.000*	-0.859	*0.000*	-0.657	*0.000*
	$\overline{R}^2$	0.917		0.916		0.925		0.933	
Germany	*ΔS&P*	0.702	*0.000*	0.660	*0.000*	0.694	*0.000*	0.760	*0.000*
	ΔS&P_Synchronized	-0.342	*0.000*	-0.563	*0.000*	-0.506	*0.000*	-0.683	*0.000*
	Prem	-0.003	*0.548*	-0.009	*0.096*	-0.024	*0.000*	-0.069	*0.000*
	Prem_Open	-0.797	*0.000*	-0.498	*0.000*	-0.668	*0.000*	-0.791	*0.000*
	$\overline{R}^2$	0.882		0.849		0.951		0.938	
Switzerland	*ΔS&P*	0.684	*0.000*	0.610	*0.000*	0.733	*0.000*	0.770	*0.000*
	ΔS&P_Synchronized	-0.667	*0.000*	-0.569	*0.000*	-0.546	*0.000*	-0.584	*0.000*
	Prem	-0.045	*0.004*	-0.023	*0.008*	-0.054	*0.000*	-0.026	*0.003*
	Prem_Open	-0.420	*0.000*	-0.528	*0.000*	-0.866	*0.000*	-0.713	*0.000*
	$\overline{R}^2$	0.793		0.854		0.847		0.901	
Austria	*ΔS&P*	0.743	*0.000*	0.757	*0.000*	0.862	*0.000*	0.988	*0.000*
	ΔS&P_Synchronized	-0.490	*0.000*	-0.619	*0.000*	-0.552	*0.000*	-0.608	*0.000*
	Prem	0.007	*0.482*	-0.016	*0.327*	-0.029	*0.019*	-0.064	*0.000*
	Prem_Open	-0.554	*0.000*	-0.126	*0.006*	-0.714	*0.000*	-0.722	*0.000*
	$\overline{R}^2$	0.775		0.792		0.835		0.920	
Spain	*ΔS&P*	0.707	*0.000*	0.797	*0.000*	0.726	*0.000*	1.070	*0.000*
	ΔS&P_Synchronized	-0.623	*0.000*	-0.704	*0.000*	-0.589	*0.000*	-0.971	*0.000*
	Prem	0.019	*0.000*	-0.033	*0.000*	-0.023	*0.024*	-0.018	*0.014*
	Prem_Open	-0.634	*0.073*	-0.784	*0.000*	-0.538	*0.000*	-0.670	*0.000*
	$\overline{R}^2$	0.797		0.897		0.949		0.958	
France	*ΔS&P*	0.787	*0.000*	0.756	*0.000*	0.761	*0.000*	0.949	*0.000*
	ΔS&P_Synchronized	-0.766	*0.000*	-0.681	*0.000*	-0.396	*0.000*	-0.816	*0.000*
	Prem	-0.008	*0.570*	-0.035	*0.000*	-0.026	*0.020*	-0.029	*0.001*
	Prem_Open	-0.325	*0.000*	-0.697	*0.000*	-0.671	*0.000*	-0.634	*0.000*
	$\overline{R}^2$	0.786		0.852		0.945		0.958	
United Kingdom	*ΔS&P*	0.641	*0.000*	0.840	*0.000*	0.746	*0.000*	0.858	*0.000*
	ΔS&P_Synchronized	-0.622	*0.000*	-0.696	*0.000*	-0.259	*0.000*	-0.775	*0.000*
	Prem	-0.024	*0.001*	-0.010	*0.010*	-0.035	*0.000*	-0.045	*0.000*
	Prem_Open	-0.525	*0.000*	-0.819	*0.000*	-0.456	*0.000*	-0.562	*0.000*
	$\overline{R}^2$	0.831		0.894		0.885		0.888	
Turkey	*ΔS&P*	NA	*NA*	1.128	*0.000*	0.885	*0.000*	1.010	*0.000*
	ΔS&P_Synchronized	NA	*NA*	0.002	*0.998*	-0.527	*0.000*	-0.634	*0.000*
	Prem	NA	*NA*	-0.051	*0.018*	-0.010	*0.386*	-0.014	*0.001*
	Prem_Open	NA	*NA*	-0.489	*0.018*	-0.616	*0.000*	-0.531	*0.000*
	$\overline{R}^2$	NA		0.749		0.811		0.882	

Notes: This table reports regression results for our model as defined in Equation (1) for European country ETFs, this time for each year separately: 2007-2010. See Table 3 for regression specifications and variable definitions. We report results for variables of interest: S&P returns (ΔS&P); additional S&P returns during synchronized trading hours (ΔS&P_Sync); lagged ETF premiums or discounts (Prem); and additional lagged ETF premiums or discounts at the US market-open (Prem_open). All time intervals are calculated on a 15-minute base.